Family Mealtime Frequency and Household Food Availability in US Adults Living in Multi-Person Households: NHANES 2007-2010

Honors Research Thesis

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ABSTRACT

Family meals are associated with improved diet quality among children and adolescents, and are increasingly promoted as a strategy to improve public health and prevent obesity. However, the extent of this association among the general US population has not been studied. This research seeks to describe the prevalence of family meals among US adults, and the relationship between family meal frequency and home food availability. Data were analyzed from the 2007-2008 and 2009-2010 cycles of the National Health and Nutrition Examination Survey (NHANES), a nationally representative survey of the US civilian population. Our sample included 18,031 adults living in households of two or more people who were asked questions regarding sociodemographic characteristics, family mealtime frequency, and the availability of various foods in the household. Analysis performed in SAS included Chi-square tests and cumulative logistic regression models. Among the US population living in multiple person households, the prevalence (95% CI) of having 0-2, 3-6, and ≥7 family meals per week was 18.0% (16.6-19.3), 32.4% (31.0-33.9), and 49.6% (47.8-51.4), respectively. Frequency of family meals varied with sociodemographic characteristics, with respondents who were older, poorer, Hispanic, married, and had less education reporting more frequent family meals. In addition, a healthier pattern of household food availability, as measured by our aggregate food availability score, was associated with greater frequency of family meals at home. Family meals are common in US households, with about half of all US households with two or more people eating ≥7 family meals per week. Family meal frequency was also positively associated with a healthier pattern of household food availability. Our research suggests that frequent family meals have positive nutritional benefits for adults as well as children, which could have an impact on future public health and nutrition interventions.

INTRODUCTION

The goal of the project was to describe the epidemiology of family meals in United States adults, and investigate the relationship between family meal frequency and the availability of healthy foods in the home. We sought to describe the relationship between sociodemographic characteristics, frequency of family meals, and home food availability.

The frequency and benefits of family meals among children and adolescents are well documented. More frequent family meals among children and adolescents were associated with a reduction in odds of overweight status [1]. Rollins *et al.* and Goldfield *et al.* both show that family meals were inversely associated with BMI among female children and adolescents but not male [2-3]. Neumark-Sztainer and colleagues found a lower likelihood of reporting disordered eating behaviors and substance abuse among adolescents who had more frequent family meals [4-5]. Musick described strong associations between the frequency of family meals and lower levels of depressive symptoms and delinquent acts among teens [6]. Family meals appear to protect children and adolescents from these risky behaviors, perhaps by providing social support in the form of a place to connect with family members.

In addition to the psychological benefits, other researchers have found nutritional benefits among those who have frequent family meals as well. Gillman and colleagues showed that eating family dinner was associated with healthful dietary intake patterns, including more fruits and vegetables, less fried food and soda, higher intake of healthful nutrients, and lower intake of saturated and trans fat among children and adolescents [7].

Project EAT, conducted by Neumark-Sztainer and colleagues at the University of Minnesota, studied nutritional behaviors of adolescents, including family meals. The first wave of Project EAT was conducted during the 1998-1999 school year, and surveyed 4,746

adolescents and 902 parents from thirty-one public schools in the St. Paul/Minneapolis area about their eating habits. Five years later, a follow-up study, Project EAT-II, was conducted, in which 2,516 of the adolescents and young adults who participated in Project EAT-I were mailed surveys about their current eating behaviors [4]. With data from this follow-up study, Neumark-Sztainer and colleagues found that not only were there associations between family meals and better dietary intake, these benefits may persist through adolescence to early young adulthood [4, 8]. Larson also demonstrated that family meals in adolescence were associated with better diet quality and greater frequency of shared meals among young adults, suggesting that the habit of family meals persists in young adulthood [8].

As compared to children and adolescents, less is known about family meals among adults. Most studies of family meals study adults only when they are the parents of the children or adolescents already under study. Chan and Sobal studied the relationship between family meals and body weight among family members touring a college campus. They found an inverse association between frequency of family meals and body weight for all members of the family – the more frequent family meals, the lower the body weight. However, they found that this association was strongest for fathers [9].

More broadly, Sobal and Hanson interviewed 882 adults through the 2009 Cornell National Social Survey, a telephone survey using random digit dialing to sample individuals, to examine the prevalence and predictors of adult family meals and body weight. They showed that the overall frequency of family meals among adults was not significantly associated with body weight. Further analysis revealed an inverse association with family meals and body weight among adults with children, and no association among adults without children [10].

One study that does specifically look at adults is Tumin and Anderson's study of family meals among 14,057 Ohio adults, using data from the Ohio Medicaid Assessment Survey [11]. They found that sociodemographic characteristics such as being female, not currently working, having lower education, and being married were associated with a higher prevalence of family meals. They also looked at the difference between adults living with and not living with minor children, and found similar prevalence of family meals for both families living with minor children (47% had 6-7 family meals per week) and those adults who did not have minor children living in their household (51%).

There are challenges to measuring family meals and nutritional quality. For example, there are measurement differences in the survey questions that seek to quantify family meal prevalence. Some surveys count only dinner or supper as "family meals," while other surveys consider all meals that could be shared together as "family meals."

Another difference arises from who is answering the question. A large percentage of family meal research is focused on children and adolescents, but there is evidence that parents are more likely to report eating more family meals than adolescents [12]. Parents seem to value family meals more than adolescents – 82.7% of parents strongly agreed that “It’s important that our family eat a meal together,” while only 23.4% of adolescents strongly agreed [12]. Failing to ask adults or parents about family meals could underestimate their prevalence.

There are also many ways to measure nutritional quality. Many methods are self-reported, including food frequency questionnaires, which present the respondent with a list of common foods and ask how often the respondent eats them, 24-hour food recalls, which ask the respondent what they ate in the last 24 hours, and dietary diaries, which require the respondent to record what they eat for a period of time. There are also many ways to interpret the data from

these measures. Some outcomes in the literature are broad, and measure dietary intake of vegetables, fruits, fried foods, soda, and salty snacks. Others are more specific, and measure specific quantities of nutritional interest, such as total fat, saturated fat, sodium, fiber, calcium, and many others [8].

However, there are also issues with self-reported nutritional data. Using data from the 24-hour dietary recall interview in NHANES, 1971-2010, it was estimated that energy intake was under-reported, and that obese men and women may under-report daily calories by 800 kilocalories per day [13]. Under-reported calories may be influenced by social desirability, the tendency of respondents to answer questions in a way that will present themselves in the best possible light. Although our study does not use the 24-hour dietary recall, we do use other self-reported nutritional data that could be subject to social desirability bias.

Many of these methods focus on the individual's nutritional quality, but our data focuses on the household level. We wanted to measure the nutritional quality of a household, as family meals are also a household level variable. We chose to focus on home food availability. Various studies have shown that the home food environment, or the availability and accessibility of foods in the home, is associated with consumption of those foods among children and adolescents [14-15]. Using home food availability allowed us to measure the nutritional quality of a household. It is not known how family meals relate to household food availability at a population level.

There are advantages to using a nationally representative survey like NHANES as opposed to the convenience samples used in previous studies of family meals among adults, like Chan and Sobal [9]. NHANES is sampled and weighted to be representative of the non-institutionalized civilian population of the United States, and results can be generalized to this population. We are able to measure associations at the population level.

In conclusion, there is currently a gap in the research on family meals among adults. The purpose of our study was to describe the prevalence of family meals among US adults living in multi-person households, and to analyze the demographic characteristics associated with frequency of family meals. We also wanted to investigate the relationship between home food availability and the frequency of family meals. We hypothesized that households that have more healthy foods and less unhealthy foods would be more likely to have more frequent family meals.

METHODS

We analyzed data from the 2007-08 and 2009-10 cycles of the National Health and Nutrition Examination Survey (NHANES), a multi-stage, stratified, clustered probability sampling design that is representative of the U.S. civilian non-institutionalized population. NHANES is conducted by the National Center for Health Statistics and has operated continuously since 1999 [16]. Each two-year cycle samples approximately 10,000 individuals selected from households chosen randomly from fifteen "primary sampling units" (PSUs, usually single counties but sometimes groups of contiguous counties) across the country. If individuals are eligible for participation in the survey, they complete an in-depth, in-home interview with a trained interviewer, as well as undergo a medical examination at a mobile examination center. The sample includes an oversample of some population subgroups, including Hispanic persons, non-Hispanic black persons, low-income white persons, and persons aged 80 and over [16].

We combined data from the 2007-08 and 2009-2010 waves of NHANES according to the analytic guidelines [16]. These were the only years available that included the family meals question in the survey. First, we merged data from the Consumer Behaviors Questionnaire (CBQ) and the Demographics Information Questionnaire (DMQ) by respondent sequence number for each cycle separately. Then we appended the two files to create our dataset. Four year sampling weights were calculated according to NHANES guidelines [17].

To organize the variables for easy reference, we created a codebook. Each variable we used had a row, and in each column, information was entered: the variable name, a description of the variable, the English text of the question the variable measured, the possible values that answered the question and their meanings (e.g., 1=yes, 2=no), and the number of missing respondents. The codebook is included in the Appendix.

NHANES selects one or more sample persons from each household to be interviewed and examined. However, the sample person is not always asked every question – in some cases, such as if the sample person is 16 years of age or younger, a separate household reference person is chosen to answer questions about the household in their place. The household reference person is the person who owns or rents the residence where the sample person lives. The household reference person can be the same person as the sample person. The household reference person was asked their gender, age, education level, marital status, and country of birth. The Consumer Behaviors Questionnaire collects information on respondents' knowledge, attitudes, and beliefs toward nutrition and food choices. Because it measures these topics at the family level, the household reference person answers the Consumer Behaviors Questionnaire.

Family meal frequency was measured by a question in the Consumer Behaviors Questionnaire, which asked, "During the past 7 days, how many meals did all or most of your family sit down and eat together at home?" Respondents could provide a whole number, though if the respondent answered a number greater than 21, the interviewer clarified that the family ate at home more than three meals per day. The question was only asked to respondents who did not live alone. We categorized family meals as 0-2 meals per week, 3-6 meals per week, and $\geq$7 meals per week. These groupings allowed comparability with other family meal research.

Availability of different foods (fruits, dark green vegetables, salty snacks, and sugar-sweetened beverages) was measured with questions in the Consumer Behaviors Questionnaire. For fruits, the question was asked, "How often does your family have fruits available at home? This includes fresh, dried, canned and frozen fruits. Would you say always, most of the time, sometimes, rarely, or never?" These five responses were the same for the other food availability questions. Dark green vegetable availability was assessed with the question, "How often does

your family have any of these dark green vegetables available at home? This includes fresh, dried, canned and frozen vegetables." Here a card with the options, "bok choy, broccoli, collard greens, dark green leafy lettuce, kale, mesclun, mustard greens, romaine lettuce, turnip greens, spinach, watercress" was provided to the respondent, and if the respondent asked, the interviewer clarified that the question, "Does not include iceberg, butterhead, boston, and monoa lettuce."

Salty snacks availability was assessed with the question, "How often does your family have salty snacks such as chips and crackers available at home? Do not include nuts." Finally, soft drink availability was assessed with the question, "How often does your family have sugar-sweetened beverages, fruit-flavored drinks, or fruit punch available at home? Please do not include diet drinks, 100 percent juice or sports drinks."

We created an aggregate measure of household food availability to investigate the relationship between overall food availabilities and family meal frequency. To construct this healthy food availability score, we combined information from the four food availability questions. Responses to each food availability question were scored as 1 if they were a healthy response, and 0 if they were not. For the fruits and dark green vegetables questions, "always" and "most of the time" were the healthy responses, and for salty snacks and sugar-sweetened beverages, "rarely" and "never" were the healthy responses. The sum of these scores was the aggregate healthy food availability score. A score of 4 was the healthiest (indicating high availability of fruits and dark green vegetables, and low availability of salty snacks and sugar-sweetened beverages), and a score of 0 was the lowest (indicating low availability of fruits and dark green vegetables, and high availability of salty snacks and sugar-sweetened beverages).

Age was reported as a continuous variable, with top coding for responses 80 and over to protect confidentiality. We created four categorical variables for the household reference person's

age: 18-25 years, 26-45 years, 46-64 years, and ≥65 years. Education was measured by asking, "What is the highest grade or level of school you have completed or the highest degree you have received?" We categorized answers into five levels: <9th grade, 9th-11th grade, high school/GED equivalent, some college, and college graduate. Marital status was assessed by asking, "Are you now married, widowed, divorced, separated, never married or living with a partner?" We combined these answers into three categories: married/living with partner, divorced/separated/widowed, and never married. Country of birth was measured by asking, "In what country were you born?" We categorized the answers as "United States" or "other country." We created three categories for the family's income to poverty ratio, <1.3, 1.3-3.5, and >3.5. The income to poverty ratio measures the ratio of a family's income to the federal poverty threshold for a family of that size. The cutoff points we selected were chosen for ease of comparison with other studies, and also because they correspond to government benefits thresholds. A family with a income to poverty ratio of less than 1.3 is eligible for the Supplemental Nutrition Assistance Program (SNAP). The race/ethnicity of the household reference person was not assessed, so we used the race/ethnicity of the sample person. Ethnicity was assessed by asking, "Do you consider yourself to be Hispanic or Latino?" and race was assessed by asking, "What race do you consider yourself to be? Please select 1 or more of these categories." We categorized the race/ethnicity of the sample person as Hispanic, any race, non-Hispanic white, non-Hispanic black, and other race, non-Hispanic.

The two cycles of NHANES interviewed a total of 20,686 people. We restricted our data set to focus only on people who lived in multi-person households and had answered all four food availability questions. People who lived alone did not answer the family meal frequency question, and so we did not include those 2,343 participants (11.3% of the sample). We also

excluded 312 people (1.5%) who were missing information on family meals or household food availability. Our final analytic sample included 18,031 individuals.

Data were analyzed using SAS version 9.2. All analyses were weighted to allow inference to the US non-institutionalized population living in multiple-person households and variance estimates account for the complex sample design of NHANES using the Survey Procedures in SAS [17].

We estimated the prevalence of family meal frequency of US individuals living in multiple person households overall, as well as the prevalence of family meals by various sociodemographic characteristics (age, race/ethnicity, education, marital status, income to poverty ratio, and country of birth). We performed Chi-square tests to test for differences in family meal frequency among each of the characteristics.

We also estimated the prevalence of family meal frequency by the binary measures of the food availability questions and the aggregate healthy food availability score. We performed Chi-square tests to tests for differences among these food availabilities, and used cumulative logistic regression models to estimate odds ratios. Our cutoff point for statistical significance was $p<0.05$. The outcome for the odds ratios was the 3-level frequency of family meals, the predictor was the "healthy" levels of availability of the fruits, dark green vegetables, salty snacks, and sugar-sweetened beverages, and the reference category was the less healthy levels. For the aggregate home food availability score, the odds ratio reflects the odds for a 1 unit higher score. The cumulative logistic regression models assume proportional odds and the estimated odds ratio describes both the comparison of 0-2 family meals per week to $\geq$3 family meals per week, as well as the comparison of $\leq$6 family meals per week to $\geq$7 family meals per week.

RESULTS

Figure 1 shows the unweighted response distribution of overall prevalence of family meals. A proportion of respondents have 0 family meals per week, then a much smaller proportion has 1 family meal per week. The prevalence steadily increases from 1 family meal to 5 family meals per week. Fewer respondents have 6 family meals per week, and a much larger proportion have 7 family meals per week. Fewer respondents have greater than 7 family meals per week. Overall, almost half (49.6% (95% CI: 47.8, 51.4)) of the U.S. population living in multiple person households had ≥7 family meals per week, one-third (32.4% (95% CI: 31.0, 33.9)) had 3-6 family meals per week, and 18.0% (95% CI: 16.6, 19.3) had 0-2 family meals per week.

Table 1 show that these frequencies vary within sociodemographic characteristics. Older respondents (≥65 years of age) are the most likely of the age groups to have ≥7 family meals per week, at 67.2% (95% CI: 63.9, 70.6). Younger respondents (18-25 years) are the most likely to have the fewest family meals per week, at 25.4% (95% CI: 19.1, 31.6). By race/ethnicity, the categories Hispanic and other non-Hispanic races are most likely to have ≥7 family meals per week (58.5% (95% CI: 55.3, 61.4) and 59.4% (95% CI: 53.7, 65.0), respectively). Non-Hispanic blacks were the only race to have an equal distribution of family meals across categories, with 34.0% (95% CI: 30.1, 37.9) having 0-2 meals per week, 34.3% (95% CI: 31.4, 37.1) having 3-6 meals per week, and 31.7% (95% CI: 27.9, 35.5) having ≥7 meals per week.

Respondents with <9^{th} grade education are the most likely (63.2% (95% CI: 57.6, 68.9)) to have ≥7 family meals per week, and respondents having a high school or higher education were all equally likely to have ≥7 meals per week (high school 47.6% (95% CI: 44.4, 50.9), some college 47.4% (95% CI: 44.4, 50.3), and college graduate 47.9% (95% CI: 44.6, 51.3)).

Respondents who are married or living with a partner are most likely to have ≥7 family meals per week (52.8% (95% CI: 50.6, 54.9)). Respondents who are divorced or separated are slightly more likely than respondents who were never married to have ≥7 meals per week (39.7% (95% CI: 34.8, 44.6) versus 37.3% (95% CI: 32.4, 42.2)). Respondents who have an income to poverty ratio of <1.3 are most likely to report ≥7 meals per week. Respondents who have the highest income to poverty ratio (>3.5) are the most likely to have 3-6 family meals per week (38.0% (95% CI: 35.2, 40.8)). Finally, respondents who were born outside of the U.S. are more likely to have ≥7 family meals per week (60.0% (95% CI: 56.2, 63.8)). All had Chi-square P values of <0.0001, which is statistically significant. However, the data set is very large and these P values are not surprising.

Household availabilities of fruits, dark green vegetables, salty snacks, and sugar-sweetened beverages, as well as the distribution of their binary scores, are shown in **Table 2**. A large majority (89.8% (95% CI: 88.7, 91.0)) of the U.S. population in multiple person households live in households that always or most of the time have fruits available. A slightly smaller proportion, 81.3% (95% CI: 79.8, 82.8), lives in a household that always or most of the time has dark green vegetables. Only 11.7% (95% CI: 10.5, 12.9) of the U.S. population in multiple person households live in households that rarely or never have salty snacks, but more than twice that, 26.0% (95% CI: 24.0, 28.0), live in households that rarely or never have sugar-sweetened beverages.

The distribution of the aggregate healthy food availability score is also shown in Table 2. More than half of the U.S. population living in multiple person households (55.4% (95% CI: 53.7, 57.1)) has only 2 of the healthy food availabilities. About equal proportions have all 4

healthy food availabilities (4.7% (95% CI: 4.0, 5.5)) and none of the healthy food availabilities (4.1% (95% CI: 3.3, 4.9)).

The frequency of family meals by household food availabilities is shown in **Table 3**. For all four healthy food availabilities, those with the healthy binary were more likely to have ≥7 meals per week than those with the unhealthy binary. For fruits, 51.1% (95% CI: 49.2, 53.0) of those who always or most of the time had fruits available in the household had ≥7 meals per week, compared to 36.4% (95% CI: 32.3, 40.4) of those who sometimes, rarely, or never had fruits. Half (51.7% (95% CI: 49.4, 54.0)) of those who always or most of the time had dark green vegetables had ≥7 meals per week, while only 40.4% (95% CI: 36.2, 44.7) of those who sometimes, rarely, or never had dark green vegetables had ≥7 meals per week. Similarly, 56.5% (95% CI: 51.3, 61.8) of those who rarely or never had salty snacks and 57.0% (95% CI: 53.2, 60.8) of those who rarely or never had sugar-sweetened beverages had ≥7 meals per week.

The odds ratio for having more frequent family meals was 2.08 (95% CI: 1.80, 2.41) for those who always or most of the time had fruits available in the home compared to those who sometimes, rarely, or never had fruits available in the home. This odds ratio was 1.66 (95% CI: 1.37, 2.01) for dark green vegetables. Households that rarely or never had salty snacks had odds 25% (95% CI: 2%, 55%) higher of having more frequent family meals than households that always, most of the time, or sometimes had salty snacks. Households that rarely or never had sugar-sweetened beverages similarly had 54% (95% CI: 32%, 80%) higher odds of having more frequent family meals.

The aggregate healthy food score showed a stepwise, monotonic trend for having ≥7 meals per week. Those with the highest aggregate healthy food score were the most likely (68.2% (95% CI: 61.6, 74.9)) to have ≥7 meals per week, and those with the lowest aggregate

healthy food score were the least likely (34.3% (95% CI: 26.9, 41.7)) to have ≥7 meals per week. The reverse trend is observed for having 0-2 meals per week. Those with the highest aggregate health score were the least likely to have 0-2 meals per week (11.8% (95% CI: 7.5, 16.0)), and those with the lowest aggregate health score were the most likely to have 0-2 meals per week (31.3% (95% CI: 24.7, 38.0)). The odds ratio for a 1 unit difference in the aggregate healthy food score that predicted more frequent family meals was 1.44 (95% CI: 1.33, 1.55).

DISCUSSION

We described the prevalence of family meals among the U.S. population living in multiple person households, and found that eating family meals at home was associated with availabilities of healthy foods in the household. We described various sociodemographic characteristics associated with more frequent family meals, including being older, poorer, having less education, being of Hispanic race/ethnicity, and being born in a country outside the United States. We also found an association between availability of healthy foods in the home and family meals – each point of our aggregate food availability score, measuring households having more healthy foods and less unhealthy foods available, was associated with having more frequent family meals.

We estimated that among the U.S. population living in multiple person households, half had $\geq$7 family meals per week, one-third had 3-6 family meals per week, and 18.0% had 0-2 family meals per week. We found that among this population, frequency of family meals varied by age, with adults aged 65 and older having the highest frequency of family meals (67.2% had $\geq$7 meals per week). Fulkerson and colleagues found that family meals were common across the life course, but varied with age [18]. In contrast to our findings, they found that older adults had less frequent family meals. A difference in our study is that our sample includes only the U.S. population living in multiple person households, while the studies included in Fulkerson's review included only older adults living in community settings (such as assisted living or nursing home facilities). The older adults in our sample live with others, and thus it is not surprising that they have more frequent family meals than other older adults who live in community settings without their families.

Larson and colleagues also demonstrated, using data from Project EAT-I and EAT-II, evidence that family meals persist across the life course. Project EAT-I was conducted in 1998-99 and surveyed adolescents in the St. Paul/Minneapolis area about their eating behaviors, and Project EAT-II followed up with them five years later. Larson and colleagues found that having family meals as an adolescent increased the likelihood of having shared meals as a young adult [8]. In our study, we estimated that among younger people living in households with two or more people, a higher proportion (25.4%) eat 0-2 meals per week, but many (42.4%) still eat $\geq$7 meals per week. However, Larson and colleagues found a much lower prevalence of shared meals among young adults than our study – only 21.3% of 20 to 25 year olds had $\geq$7 shared meals per week. This difference could be explained by the fact that their study sample could have included young adults who lived alone and therefore had less frequent shared meals, while our sample included only adults who live in households of two or more people. Also, our study used the age of the household reference person, although the ages of other household members might be quite different. Despite these differences, we also show similar associations between improved diet quality and frequent family meals. We describe an association between availability of healthy foods in the home, and Larson and colleagues found that having more frequent shared meals was associated with a healthier diet, including greater fruit intake for males and females and greater intakes of vegetables, milk products, and some key nutrients among females.

We show that respondents who were born outside of the United States were more likely to have $\geq$7 family meals per week as compared to respondents born in the U.S. (60.0% vs. 47.3%). Virudachalam and colleagues also found a similar pattern in their analysis of frequency of cooking at home, using data from NHANES [19]. Households with a foreign-born reference person were also more likely to cook dinner 6-7 times per week (70%, compared to 45% of

respondents born in the U.S.). Previous research has indicated that recent immigrants to the United States have healthier eating behaviors, and that living in the U.S. negatively affects immigrant's health [20]. Virudachalam also discovered similar prevalence among participants of cooking dinner 6 or 7 nights per week (49%) as our study, although we focused on only on eating family meals, not cooking them. Sociodemographic characteristics associated with cooking dinner were similar to those associated with eating family meals, including lower household income and educational attainment and race/ethnicity. Our study's findings of family meal prevalence and associated sociodemographic characteristics are in agreement with Virudachalam, while our study also focuses on specific diet quality indicators (household food availability).

Our study also adds to the literature on home food environments. The availability of healthy and unhealthy foods in a household can influence diet choices and health outcomes. Masters and colleagues demonstrated how the home food environment differs by race and ethnicity in a sample of youth aged 6 to 19, drawing on data from NHANES [21]. Masters found that high-income households had the highest prevalence of fruits and low-fat milk available. When stratified by race, white households had the highest prevalence of salty snacks, and black households had the highest prevalence of sugar-sweetened beverages and the lowest prevalence of low-fat milk. While the prevalence of family meals was reported by Masters, the relationship between food availability and family meals was not investigated. Our study looks at this relationship between family meals and home food availability, and finds that having a higher prevalence of healthy foods and a lower prevalence of unhealthy foods available is associated with having more frequent family meals. Masters and colleagues also looked only at youth aged

6 to 19, and our analysis expands this to all adults in the U.S. living in households of 2 or more people.

The large, nationally representative quality of NHANES is one of this study's strengths, but it also presents some limitations. Although we were interested in investigating a possible difference in family meals between families with and without children, we were unable to obtain information on the presence of minor children in the household because of confidentiality concerns. However, Tumin and Anderson's study of family meals [11] among a large representative sample of adults in Ohio found that frequencies of family meals were similar between families with and without minor children, and that family meals were actually slightly more prevalent among families without minor children in the household. Thus the effect of children on family meal frequency may not be significant. Another limitation is that our study is cross-sectional and observational, and so we cannot conclude any cause and effect relationships.

There are numerous areas of further study. One example includes further investigating the presence of children in the household and their effect on family meals and home food availability. Another population that could be studied are adults living alone. In 2010, the US had 116.7 million total households, of which 27% (31.2 million) were occupied by someone living alone [22]. This is a historic proportion of people living alone in the United States, and this population will continue to grow. Although people who live alone do not have family meals as measured by NHANES, they may have shared meals with friends or with family outside of or in their home. The relationship between these meals and diet quality could be explored.

Another area of study could be the obstacles and barriers to family meals. Bowen and colleagues' sociological study of home-cooking, "The Joy of Cooking?" reveals the many challenges for families cooking home meals, including erratic work schedules, low incomes that

preclude purchasing produce or even cooking supplies, and the differing tastes of family members [23]. Poor and working class families may have unpredictable work schedules, especially those working in service industry jobs, which make cooking dinner at a reasonable time difficult. Low incomes and lack of transportation impeded not only grocery shopping, especially for fresh produce, which spoils quickly, but also having cooking utensils and even kitchen tables and chairs. Finally, navigating family members' tastes and preferences was an obstacle for poor and working class families alike. Bowen notes that simply recommending family meals doesn't address these larger issues that are preventing families' abilities to make them. Public health officials must keep these real-world considerations in mind when recommending family meals, and work with families to overcome these obstacles.

Finally, a family meals intervention to improve diet quality, weight loss, or other obesity-related health outcome could be considered. Educating adults on the benefits of family meals, and helping to remove some obstacles (time, resources, cooking skills) could increase the frequency of family meals and perhaps other health outcomes. An experiment like this would allow us to describe a cause and effect relationship that our current study design does not allow.

In conclusion, we found that frequent family meals are common among all households in the U.S., but some sociodemographic characteristics, such as being older, poorer, married, and having less education, are associated with more common family meals. Having a more healthy pattern of food availability at home – i.e., frequently having fruits and vegetable and infrequently having salty snacks and sugar-sweetened beverages – is also associated with having more frequent family meals. Frequent family meals may also have positive nutritional benefits for adults, which could have an impact on future public health and nutrition interventions.

PERSONAL REFLECTION

On a personal note, this project was a tremendous learning experience for me. In addition to learning how to use SAS, how to write a manuscript, and how to conduct statistical analysis, among many other things, I also learned, looking back, of a few things that I would do differently next time. I learned the valuable skill of letting things go. I was reluctant to let go of a method if we had spent a lot of time on it because I didn't want to feel like I had wasted any time. Unfortunately, it seems like that's fairly unavoidable, and it helped to learn to let things go.

One of the reasons I decided to do an undergraduate thesis was that I was considering graduate school, and wanted to see if I enjoyed doing research. Luckily (because I am going to graduate school this fall), I really did enjoy it. I liked learning how to use SAS, writing a manuscript, and presenting a poster at a research forum, among many other parts of the process. Overall, it was a great experience, and I look forward to future research projects.

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Figure 1: Unweighted distribution of family meals among U.S. population living in multiple person households, NHANES 2007-2010

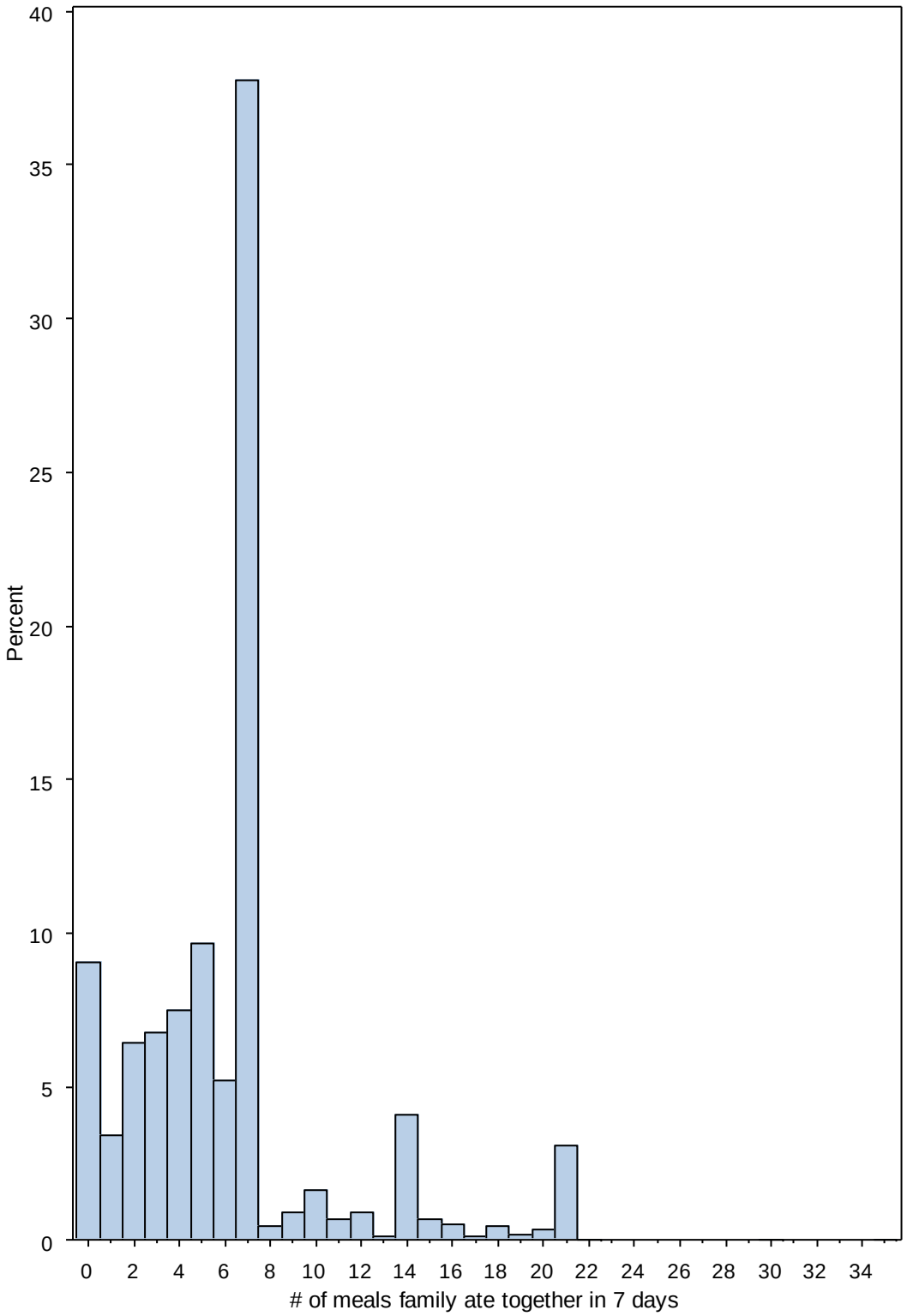

Table 1: Family meal frequency in U.S. multi-person households by sociodemographic characteristics of the householder

	n[a]	Frequency of family meals at home in the past week, Percentage (95% CI)[b]			
		0-2 meals/week	3-6 meals/week	≥7 meals/week	P value[c]
Overall	18031	18.0 (16.6, 19.3)	32.4 (31.0, 33.9)	49.6 (47.8, 51.4)	
Age					
18-25 years	1471	25.4 (19.1, 31.6)	32.2 (25.6, 38.8)	42.4 (37.2, 47.6)	<0.0001
26-45 years	9108	16.7 (15.1, 18.2)	33.8 (31.9, 35.7)	49.6 (47.4, 51.8)	
46-64 years	5119	20.6 (18.3, 22.9)	34.7 (32.3, 37.2)	44.7 (41.8, 47.5)	
≥65 years	2333	11.9 (9.0, 14.7)	20.9 (18.0, 23.8)	67.2 (63.9, 70.6)	
Race/ethnicity[d]					
Hispanic, any race	6289	17.6 (15.5, 19.7)	24.1 (21.6, 26.5)	58.5 (55.3, 61.4)	<0.0001
Non-Hispanic white	7155	15.4 (13.6, 17.3)	34.9 (33.0, 36.8)	49.7 (47.7, 51.6)	
Non-Hispanic black	3595	34.0 (30.1, 37.9)	34.3 (31.4, 37.1)	31.7 (27.9, 35.5)	
Other race, non-Hispanic	992	14.4 (9.7, 19.2)	26.2 (20.3, 32.1)	59.4 (53.7, 65.0)	
Education					
<9th grade	2148	17.6 (13.2, 22.0)	19.2 (15.8, 22.5)	63.2 (57.6, 68.9)	<0.0001
9th-11th grade	3134	19.4 (15.6, 23.3)	25.1 (21.1, 29.1)	55.5 (51.4, 59.5)	
High School/GED equivalent	4322	21.0 (17.8, 24.2)	31.4 (27.9, 34.9)	47.6 (44.4, 50.9)	
Some college	4627	18.5 (15.5, 21.5)	34.2 (31.5, 36.9)	47.4 (44.4, 50.3)	
College graduate	3320	13.7 (11.4, 16.0)	38.3 (35.1, 41.6)	47.9 (44.6, 51.3)	
Marital status					
Married	12935	14.9 (13.3, 16.5)	32.4 (30.4, 34.3)	52.8 (50.6, 54.9)	<0.0001
Divorced/separated	2749	27.6 (23.1, 32.1)	32.7 (28.4, 37.0)	39.7 (34.8, 44.6)	
Never married	1890	29.9 (24.1, 35.8)	32.8 (28.0, 37.5)	37.3 (32.4, 42.2)	
Income to poverty ratio					
<1.3	6290	19.7 (17.6, 21.7)	24.4 (21.8, 27.1)	55.9 (52.7, 59.1)	<0.0001
1.3-3.5	6042	18.3 (16.2, 20.5)	32.4 (29.4, 35.4)	49.3 (45.9, 52.6)	
>3.5	4198	16.5 (14.5, 18.5)	38.0 (35.2, 40.8)	45.5 (42.9, 48.2)	
Country of birth					
U.S.	12439	18.1 (16.6, 19.6)	34.6 (32.8, 36.5)	47.3 (45.2, 49.3)	<0.0001
Foreign born	5153	17.0 (15.1, 18.8)	23.0 (20.1, 26.0)	60.0 (56.2, 63.8)	

[a] Unweighted sample n. Data were missing on education for 480, marital status for 457, income-to-poverty ratio for 1501, and country of birth for 439 respondents.
[b] Percentages are weighted and 95% confidence intervals account for the complex sample design. Percentages may not total 100% due to rounding.
[c] P-value for difference in groups from Rao-Scott design-corrected Chi-square.
[d] Race/ethnicity of the sampled participant.

Table 2: Home availability of fruits, dark green vegetables, salty snacks, and sugar-sweetened beverages for U.S. multi-person households: NHANES 2007-10

Food category			Percentage (95% CI)[b]	
	Home availability	n[a]	Distribution	Scored[c]
Fruits				
	Always	12428	71.5 (69.3,73.7)	
	Most of the time	3566	18.3 (16.8, 19.9)	89.8 (88.7, 91.0)
	Sometimes	1676	8.2 (7.2, 9.2)	
	Rarely	324	1.8 (1.3, 2.3)	10.2 (9.0, 11.3)
	Never	37	0.2 (0.1, 0.3)	
Dark green vegetables[d]				
	Always	10543	58.5 (56.5, 60.5)	
	Most of the time	4031	22.8 (21.2, 24.5)	81.3 (79.8, 82.8)
	Sometimes	2602	13.7 (12.2, 15.2)	
	Rarely	591	3.4 (2.9, 3.9)	18.7 (17.2, 20.2)
	Never	264	1.6 (1.1, 2.1)	
Salty snacks				
	Always	7385	45.2 (42.7, 47.7)	
	Most of the time	3319	19.6 (18.5, 20.7)	88.3 (87.1, 89.5)
	Sometimes	4731	23.5 (21.5, 25.5)	
	Rarely	1988	9.2 (8.1, 10.2)	
	Never	608	2.5 (2.1, 2.9)	11.7 (10.5, 12.9)
Sugar-sweetened beverages				
	Always	7453	42.8 (40.2, 45.4)	
	Most of the time	2662	14.2 (13.0, 15.4)	74.0 (72.0, 76.0)
	Sometimes	3514	16.9 (15.4, 18.5)	
	Rarely	2361	13.7 (12.2, 15.2)	
	Never	2041	12.3 (11.1, 13.4)	26.0 (24.0, 28.0)
Aggregate healthy food availability score[e]				
	4 (high)	943	4.7 (4.0, 5.5)	
	3	3760	21.6 (20.1, 23.2)	
	2	9975	55.4 (53.7, 57.1)	
	1	2564	14.1 (12.6, 15.6)	
	0 (low)	789	4.1 (3.3, 4.9)	

[a] Unweighted sample n.

[b] Percentages weighted and may not add up to 100% due to rounding; 95% CIs account for complex survey design.

[c] Binary variables coded as 1 for healthier (shaded) response and 0 for less healthy (unshaded) response.

[d] Dark green vegetables were bok choy, broccoli, collard greens, dark green leafy lettuce, kale, mesclun, mustard greens, romaine lettuce, turnip greens, spinach, watercress.

[e] Aggregate healthy food availability score is the sum of the binary responses.

Table 3: Household food availability and family meal frequency in U.S. multi-person households: NHANES 2007-10

Household food availability	Frequency of family meals at home in the past week, Percentage (95% CI)[a]				Odds ratio[b]
	0-2 meals/week	3-6 meals/week	≥7 meals/week	P value	(95% CI)
Fruits					
Always or most of the time	16.3 (15.0, 17.7)	32.5 (31.1, 34.0)	51.1 (49.2, 53.0)	<0.0001	2.08 (1.80, 2.41)
Sometimes, rarely, or never	32.3 (28.2, 36.5)	31.3 (25.8, 36.8)	36.4 (32.3, 40.4)		1.0 (reference)
Dark green vegetables					
Always or most of the time	16.1 (14.4, 17.9)	32.1 (30.3, 34.0)	51.7 (49.4, 54.0)	<0.0001	1.66 (1.37, 2.01)
Sometimes, rarely, or never	25.9 (22.6, 29.1)	33.7 (29.6, 37.8)	40.4 (36.2, 44.7)		1.0 (reference)
Salty snacks					
Rarely or never	18.8 (15.2, 22.3)	24.7 (21.1, 28.3)	56.5 (51.3, 61.8)	0.03	1.25 (1.02, 1.55)
Always, most of the time, or sometimes	17.9 (16.4, 19.3)	33.4 (31.8, 35.1)	48.7 (46.8, 50.6)		1.0 (reference)
Sugar-sweetened beverages					
Rarely or never	12.6 (10.4, 14.8)	30.4 (27.4, 33.5)	57.0 (53.2, 60.8)	<0.0001	1.54 (1.32, 1.80)
Always, most of the time, or sometimes	19.8 (18.2, 21.5)	33.1 (31.2, 35.0)	47.0 (45.1, 49.0)		1.0 (reference)
Aggregate healthy food availability score					
4 (high)	11.8 (7.5, 16.0)	20.0 (14.4, 25.7)	68.2 (61.6, 74.9)		
3	11.6 (9.3, 14.0)	32.2 (29.3, 35.1)	56.2 (52.4, 59.9)		
2	17.8 (15.7, 19.9)	33.1 (30.7, 35.5)	49.1 (46.6, 51.6)	<0.0001	1.44[c] (1.33, 1.55)
1	26.4 (23.3, 29.5)	33.7 (29.4, 37.9)	39.9 (35.9, 44.0)		
0 (low)	31.3 (24.7, 38.0)	34.4 (25.0, 43.7)	34.3 (26.9, 41.7)		

[a] Percentages are weighted and 95% CI account for the complex sample design.

[b] Odds ratio from cumulative logistic (proportional odds) models; outcome = frequency of family meals (3-level variable), predictor = food availability (binary variable with less healthy response as the reference category).

[c] Odds ratio is for a 1 unit difference (higher) aggregate healthy food availability score.

Appendix A: Codebook

Variable Name	Description	English Text	Code Values & Description	# Missing variables
SEQN	Respondent sequence number	Respondent sequence number		0
CBD010	Anyone in the family on a special diet	Is anyone in this family on any kind of diet, either to lose weight or for some other health-related reason?	1, yes 2, no 7, refused 9, don't know . , missing	Don't know=9 Missing = 229
CBQ020	Fruits available at home	The next questions ask how often {your family has/you have} certain types of food available at home. How often {does your family/do you} have fruits available at home? This includes fresh, dried, canned and frozen fruits. Would you say always, most of the time, sometimes, rarely, or never?	1, always 2, most of the time 3, sometimes 4, rarely 5, never 77, refused 99, don't know . , missing	Refused =1
CBQ030	Dark green vegetables available at home	How often {does your family/do you} have any of these dark green vegetables available at home? This includes fresh, dried, canned, and frozen vegetables. [Would you say always, most of the time, sometimes, rarely, or never?] Does not include iceberg, butterhead, boston and monoa lettuce.	1, always 2, most of the time 3, sometimes 4, rarely 5, never 77, refused 99, don't know . , missing	Refused = 2 Don't know = 4
CBQ040	Salty snacks available at home	How often {does your family/do you} have salty snacks such as chips and crackers available at home? Do not include nuts. [Would you say always, most of the time, sometimes, rarely, or never?]	1, always 2, most of the time 3, sometimes 4, rarely 5, never 77, refused 99, don't know	Refused = 2

			. , missing	
CBQ050	Fat-free/low fat milk available at home	How often {does your family/do you} have 1% fat, skim or fat-free milk available at home? Please do not include 2% milk. [Would you say always, most of the time, sometimes, rarely, or never?] Does not include soy milk.	1, always 2, most of the time 3, sometimes 4, rarely 5, never 77, refused 99, don't know . , missing	Refused = 1 Don't know = 8
CBQ060	Soft drinks available at home	How often {does your family/do you} have soft drinks, fruit-flavored drinks, or fruit punch available at home? Please do not include diet drinks, 100 percent juice or sports drinks. [Would you say always, most of the time, sometimes, rarely, or never?]	1, always 2, most of the time 3, sometimes 4, rarely 5, never 77, refused 99, don't know . , missing	Refused = 2
CBD070	Money spent at supermarket/grocery store	The next questions are about how much money {your family spends/you spend} on food. First I'll ask you about money spent at supermarkets or grocery stores. Then we will talk about money spent at other types of stores. During the past 30 days, how much money {did your family/did you} spend at supermarkets or grocery stores? Please include purchases made with food stamps.	0 to 7000, range of values 777777, refused 999999, don't know . , missing	Refused = 20 Don't know = 306
CBD090	Money spent on nonfood items	About how much money was spent on nonfood items?	0 to 1071, range of values 777777, refused 999999, don't know . , missing	Refused = 21 Don't Know = 382 Missing = 13

CBD110	Money spent on food at other stores	About how much money {did your family/did you} spend on food at these types of stores? (Please do not include any stores you have already told me about.)	0 to 1285, range of values 777777, refused 999999, don't know . , missing	Refused = 14 Don't know = 210
CBD120	Money spent on eating out	During the past 30 days, how much money {did your family/did you} spend on eating out? Please include money spent in cafeterias at work or at school or on vending machines, for all family members.	0 to 3000, range of values 777777, refused 999999, don't know . , missing	Refused = 15 Don't know = 534
CBD130	Money spent on carryout/delivered foods	During the past 30 days, how much money {did your family/did you} spend on food carried out or delivered? Please do not include money you have already told me about.	0 to 1285, range of values 777777, refused 999999, don't know . , missing	Refused = 11 Don't know = 248
CBQ140	How often do you do major food shopping	How often {do you/do you or someone else} do the major food shopping for {yourself/your family}? Please do not include times when {you buy/someone buys} only a few items. Would you say…	1, More than once a week 2, once a week 3, once every two weeks or 4, once a month or less? 5, rarely make any major shopping trips, only small trips 6, rarely shop for food 77, refused 99, don't know . , missing	Refused = 4 Don't know = 19
CBD150	Time to get to grocery store	How much time does it usually take you to get to the grocery store for food shopping?	0 to 360, range of values (in minutes) 777777, refused 999999, don't know . , missing	Refused = 5 Don't know = 45 Missing = 92
CBD160	# of times someone cooked at home	During the past 7 days, how many times did {you or someone else in your family/you} cook food for dinner or supper at home?	0 to 30, range of values (number of times in 7 days) 777, refused 999, don't know . , missing	Refused = 8 Don't know = 7

CBD170	Time spent cooking dinner/cleaning up	How much time do {you or someone else in the family/do you} usually spend on cooking dinner or supper and cleaning up after the cooking? Please do not include time spent eating.	0 to 720, range of values (minutes) 77777, refused 99999, don't know . , missing	Refused = 9 Don't know = 114 Missing = 946
CBD180	# of meals family ate together in 7 days	During the past 7 days, how many meals did all or most of your family sit down and eat together at home?	1 to 35, range of values 0, never 666, single person family 777, refused 999, don't know . , missing	Refused = 20 Don't know = 306
CBQ190	# of meals ate together cooked at home	How many of these meals were cooked at home? Missing n large because of skip pattern from CBD180	0 to 35, range of values 777, refused 999, don't know . , missing	Don't know = 2 Missing = 3978
SDDSRVYR	Data Release Number	Data Release Number	5, NHANES 2007-2008 Public Release . , missing	0
RIDSTATR	Interview/Examination Status	Interview and Examination Status of the Sample Person	1, Interviewed only 2, both interviewed and MEC examined . , missing	0
RIDEXMON	Six month time period	Six month time period when examination was performed	1, November 1 through April 30 2, May 1 through October 31 . , missing	Missing = 627
RIAGENDR	Gender	Gender of the sample Person	1, male 2, female . , missing	0
RIDAGEYR	Age at screening adjudicated – recode	Best age in years of the sample person at time of HH screening, >80 topcoded at 80	0 to 79, range of ages 80, >= 80 . , missing	0

RIDAGEMN	Age in months at screening – recode	Best age in months at date of screening for individuals under 80 years of age	0 to 959, range of values . , missing	Missing = 856
RIDAGEEX	Age in months at exam	Best age in months at date of examination for individuals under 80 years of age at screening	0 to 959, range of values . , missing	Missing = 1414
RIDRETH1	Race/ethnicity – recode	Recode of reported race and ethnicity information	1, Mexican American 2, Other Hispanic 3, Non-Hispanic White 4, Non-Hispanic Black 5, Other Race – Including Multi-Racial . , missing	0
DMDHHSIZ	Total number of people in the Household	Total number of people in the Household	1 to 6, range of values 7, 7 or more people in the Household . , missing	0
DMDFMSIZ	Total number of people in the Family	Total number of people in the Family	1 to 6, range of values 7, 7 or more people in the Family . , missing	0

INDFMIN2	Annual family income	Total family income (reported as a range in dollars)	1, 0 to 4999 2, 5000 to 9999 3, 10,000 to 14,999 4, 15,000 to 19,999 5, 20,000 to 24,999 6, 25,000 to 34,999 7, 35,000 to 44,999 8, 45,000 to 54,999 9, 55,000 to 64,999 10, 65,000 to 74,999 12, over 20,000 13, under 20,000 14, 75,000 to 99,999 15, 100,000 and over 77, refused 99, don't know . , missing	Refused = 322 Don't know = 381 Missing = 4
INDFMPIR	Ratio of family income to poverty	A ratio of family income to poverty threshold	0 to 4.99, range of values 5, value greater than or equal to 5.00 . , missing	Missing = 1669
DMDHRGND	HH Ref person gender	Gender of the household reference person	1, male 2, female . , missing	0
DMDHRAGE	HH Ref person age	Age in years of the HH reference person at the time of HH screening, individuals >80 topcoded at 80	18 to 79, range of values 80, >= 80 years of age . , missing	0

DMDHRBR2	HH ref person country of birth	In what country {were you/was non-SP head} born?	1, born in 50 US states or Washington, DC 2, born in Mexico 4, born in other Spanish speaking country 5, born in other non-Spanish speaking country 7, refused 9, don't know . , missing	Refused = 4 Don't know = 8 Missing = 484
DMDHREDU	HH Ref person education level	What is the highest grade or level of school {you have/NON_SP Head has} received?	1, less than 9th grade 2, 9-11th grade (includes 12th grade with no diploma) 3, high school grad/GED equivalent 4, some college or AA degree 5, college graduate or above 7, refused 9, don't know . , missing	Refused = 7 Don't know = 56 Missing = 482
DMDHRMAR	HH ref person marital status	Marital status of household reference person	1, married 2, widowed 3, divorced 4, separated 5, never married 6, living with partner 77, refused 99, don't know . , missing	Refused = 74 Don't know = 9 Missing = 457

DMDHSEDU	HH ref person's spouse education level	What is the highest grade or level of school {you have/NON-SP SPOUSE has completed or the highest degree {you have/he/she has} received	1, less than 9th grade 2, 9-11th grade (includes 12th grade with no diploma) 3, high school grad/GED equivalent 4, some college or AA degree 5, college graduate or above 7, refused 9, don't know . , missing	Refused = 7 Don't know = 46 Missing = 9621
FIALANG	Language of SP interview	Language of the sample person interview instrument	1, English 2, Spanish . , missing	Missing = 5
SDMVPSU	Masked variance pseudo-PSU	Masked variance unit pseudo-psu variable for variance estimation	1 to 2, range of values . , missing	0
SDMVSTRA	Masked variance pseudo-stratum	Masked variance unit pseudo-stratum variable for variance estimation	59 to 74, range of values . , missing	0